TASK CLOSE OUT DOCUMENT

Task Scope Instrument Discrepancies: Incore TC & SPND Noise Analysis

To: M. Levenson
S. Levy
E. Zebroski

Task No. 11-6 Date Complete 4/12/79

Reason felt task is complete:
Reported

Members of Committee
D. S. Robinson
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[illegible]
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Signed
Committee Leader

160 071

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TO: SIG DISTRIBUTION

April 12, 1979

The attached document is a summary report of the TMI-2 incore diagnostics on the thermocouples and SPND's.

NORBERT J. ACKERMANN, JR.

NJA:dr
Attachment

160 072

BOOK & WILCOX COMPANY

TMI-2

SPNDS

THERMO COUPLES

MOVABLE SPND

BRIEF SUMMARY OF TESTS PERFORMED, RESULTS, CONCLUSIONS AND OPINIONS.

H. D. WARREN

P. E. MAMOLA

(B & W)

APRIL 11, 1979

TESTS PERFORMED

Redacted Nikon

A. Prop. Tests

- Insulation Resistance
- Current Measurements
- TDR checks
- Modified computer input to permit to signal [illegible] on the computer
- PSD

B. Thermocouple Tests

- Voltage measurements
- Wire resistance
- TDR checks
- Burst Tests
- Current measurements
- PSD

C. Movable Detector

- Inserted ~ 3' into fuel = maximum penetration
- TDR on detector
- PSD

160 074

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A. SPND Test Results

Insulation Resistance

29 have insulation resistance above 10^{8} ohms mostly levels 1&2

Remainder failed on testing

Current Measurements

Detectors with high insulation resistance producing signals less than 1n Ampere

Responding to gamma radiation

Signals too small to use to analysis

Detectors with low insulation resistance are producing larger signals, believed due to interaction w. the borated water

IDR

Inconclusive - no data base to make comparison

Large energy loss of detectors connector prevented obtaining useful information beyond that point

PSD

Inconclusive - no ~~use~~ meaningful signal obtained

Conclusion

The Inline detectors are probably not useable though may be ~~[illegible]~~ sensitive to temperature, however, this has not been established. G. & SPNDs (> 10 in) are sensitive to gamma and will respond to neutron flux levels above 10^{9} nv. The G. & SPNDs will not respond to temperature

us

160 075

The gas SPND appears to be failing at a rate of approximately one per day. My opinion is that this rate will continue.

B. Thermocouple Test Results

Electrical measurements (voltage, resistance, current) indicate thermocouple junctions exist in the gas cooled vessel. Since resistance measurements indicate the ~~many~~ of the thermocouples to be shorted, probably from moisture penetration, the thermocouples are believed to be reading temperatures less than that of the actual junction. The magnitude of the error could not be determined from the test results.

TDR and PSD measurements were inconclusive for the same reasons as those mentioned for the SPND.

Conclusion

Since the thermocouples will be used during cooldown and subsequent core monitoring, some conservatism should be ~~[illegible]~~ placed on the readings. Since many of the thermocouples are in essential agreement with the core inlet temperature (Tc), the conservatism to be attached to each T/C reading may be as low as 10°F. We recommend ~~[illegible]~~ when the temperature is lowest that the thermocouples be ~~[illegible]~~ repetitively monitored and compared to Tc to ~~[illegible]~~ better establish the accuracy of the readings.

160 076

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C. Movable Detector Test Results

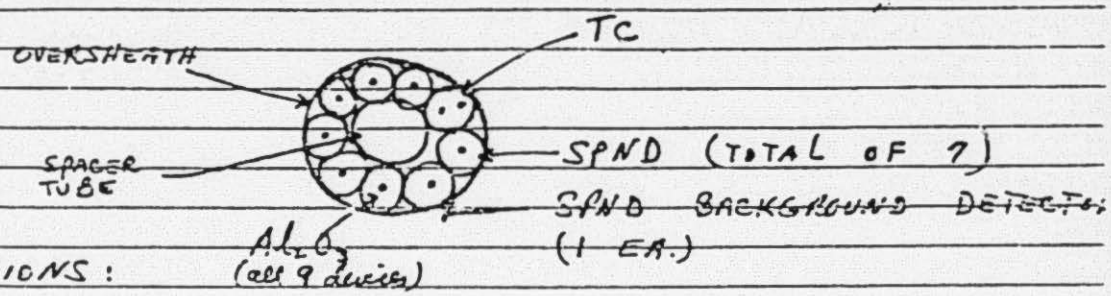
- Detector apparently has failed from moisture penetration
- No useable signal could be obtained from either of the two detector leads
- TDR and PSD provided no useful information
- Detector was inserted and withdrawn with frequent stoppages, indicating the presence of debris within the center tube
- ~~The~~ The maximum indicated insertion was approximately 3' into the core
- The detector is presently located approximately 5.5 feet below the core
- The system cabinet has been damaged

Remarks

It is our opinion that the detector moved into the core 3 feet, however, because of the system design there has no 100% certainty that this was the case

160 077

A. SPND ASSEMBLY CROSS SECTION



DIMENSIONS:

1. OVERSHEATH – INCONEL 600

   0.293" OD X 0.020" WALL

   TOTAL OVERSHEATH LENGTH : ~ 128'

2. SPACER TUBE – INCONEL 600

   0.120" OD X 0.093" ID

   TOTAL SPACER TUBE LENGTH : ~ 128'

3. SPND –

SHEATH: 0.062" OD X 0.010" WALL, INCONEL 600

LEADWIRE: 0.011" OD, ZIRCALOY 2

EMITTER: 0.0181" OD X 4.75" LONG, RHODIUM

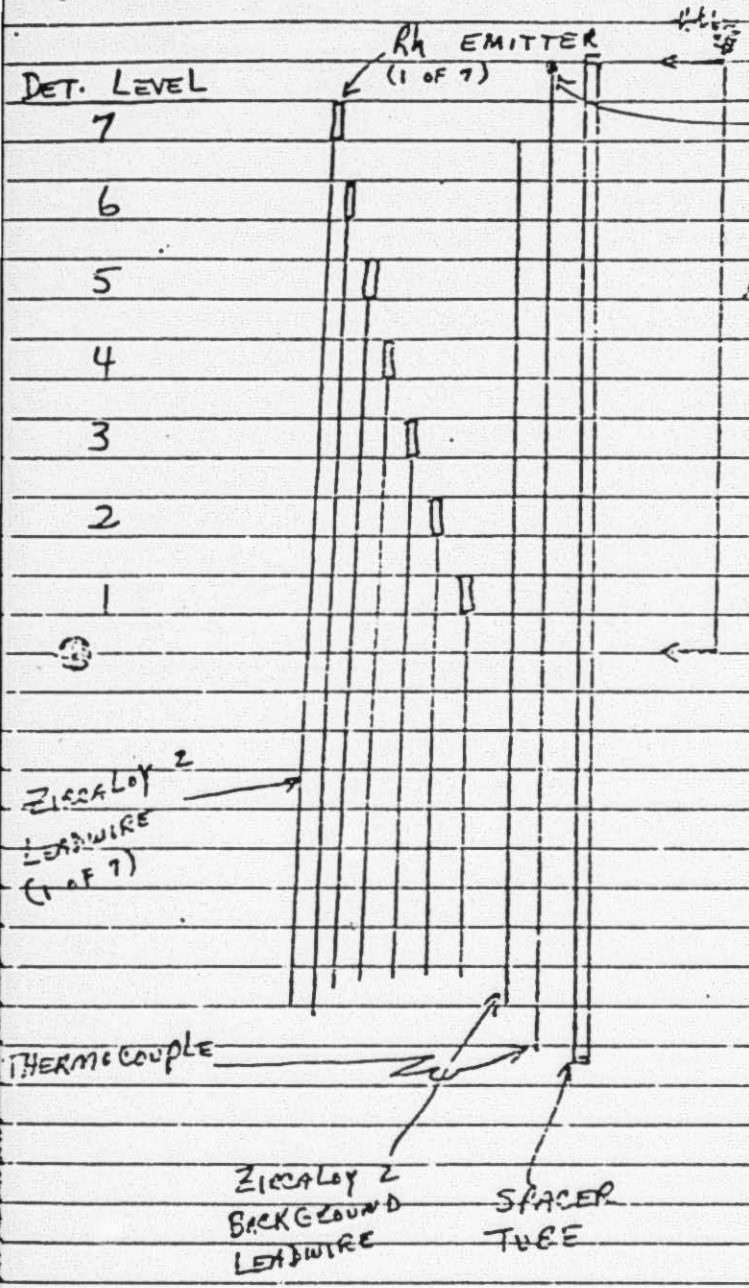
TOTAL SPND LENGTH VARIES WITH ELEVATION OF EMITTER WITHIN THE CORE. SEE FOLLOWING SKETCHES.

160 078

4. BACKGROUND DETECTOR –

SAME AS SPND EXCEPT THERE IS NO RHODIUM EMITTER.

POSITIONING OF RHODIUM EMITTERS IN CORE

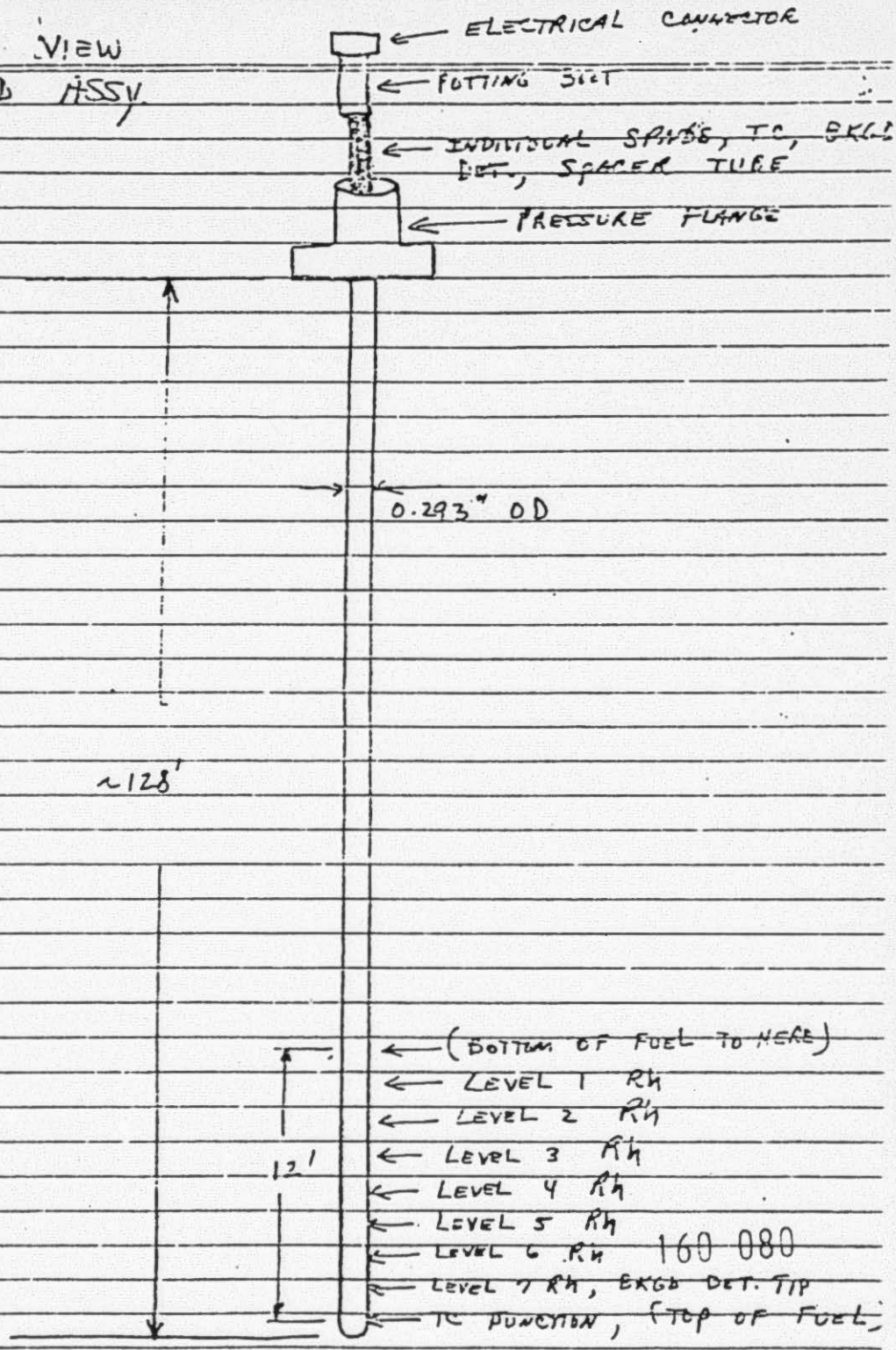


RHODIUM EMITTERS ARE SPACED EQUALLY OVER HEIGHT OF CORE. EMITTERS ARE POSITIONED MID-WAY BETWEEN FUEL SPACER GRIDS.

(SHEATHS OF DETECTORS NOT SHOWN)

160 079

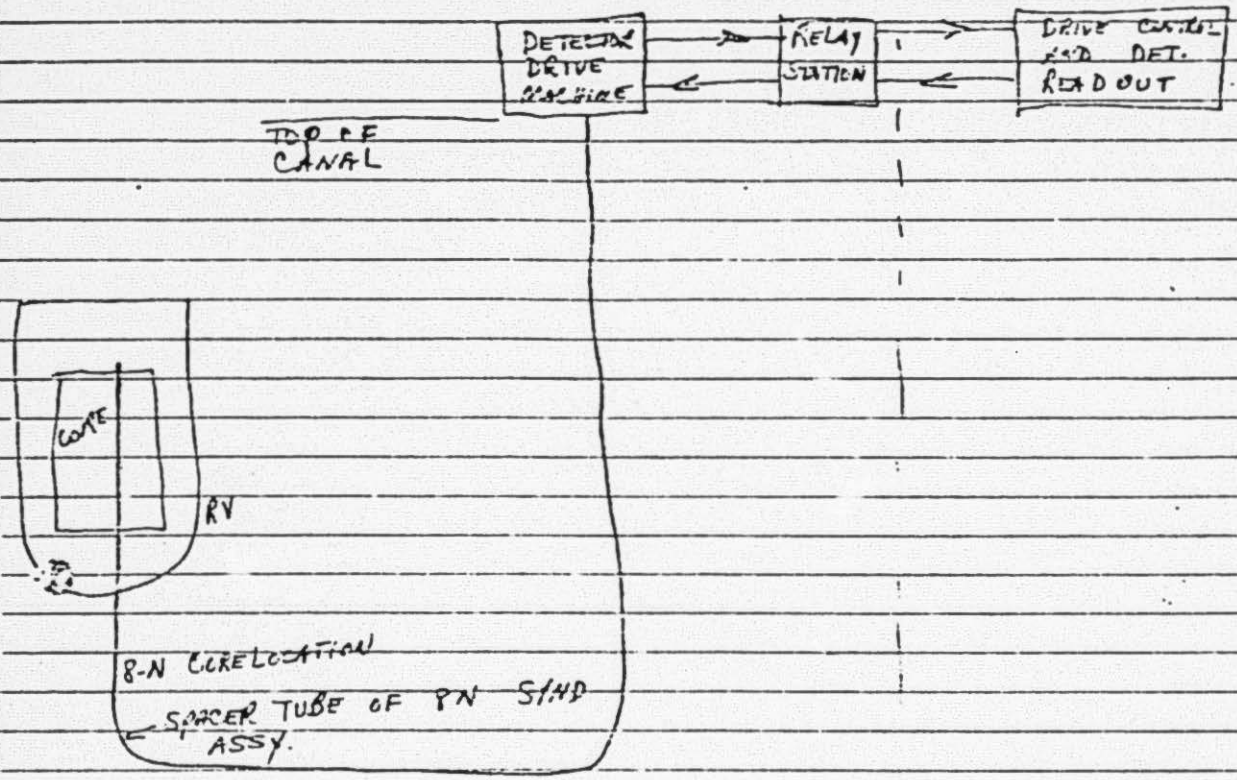
OVERALL VIEW
OF SPND ASSY.



160 080

Nace

BLOCK DIAGRAM OF MOVABLE INCORE DETECTOR SYSTEM



Movable incore detector is a twin-lead, current-responding SPND with a gadolinium emitter (0.023" x 1"). The second lead is for background compensation. The leadwires are 0.007" Inconel 600. The sheath is 0.062" OD Inconel 600. Insulation is Al_2O_3. The detector travels within the spacer tube of the SPN assy. in core location 8-N. In its parked (or withdrawn position) the tip end of the detector is approx. 9 ft. below the core bottom. When fully inserted (by the drive machine), the tip is above the top of the core.

160 081

Location	Resistance From Babcock & Wilcox Cable Room Channel to Gnd.	Resistance Measurement Box Bulb TIC Only Channel to Gnd	Resistance Difference ① - ②	Resistance From Cable Room Channel to Gnd	Resistance Measurement Bulb TIC Only Channel to Gnd	Resistance Difference ③ - ④
①	361.6 Ω	706.3 Ω	155.3 Ω	279.2 Ω	281.6 Ω	96.2 Ω
4E	813.5	652.3	161.0	351.3	260.0	91.3
10D	731.8	682.1	49.7	293.4	271.7	21.7
11E	732.4	687.4	45.0	297.7	271.4	22.3
9E	635.7	630.0	5.7	277.6	250.5	27.1
9D	693.5	635.4	58.1	291.1	258.2	32.9
14M	720.4	697.3	23.1	298.3	253.5	44.8
12D	746.7	652.0	94.7	313.1	[illegible]	[illegible]
9H	638.1	632.8	5.3	276.4	243.8	[illegible]
1H	756.1	640.0	116.1	316.7	260.0	[illegible]
2G	745.9	628.5	117.4	307.9	252.4	55.5
2L	765.8	668.3	97.5	316.1	267.0	49.1
3M	828.5	623.2	201.3	426.3	250.4	175.9
4N	734.9	636.7	98.2	311.4	253.5	57.9
5D	833.7	658.1	175.6	[illegible]	[illegible]	[illegible]
5G	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5H	1617.7	1444.9	172.8	501.0	[illegible]	[illegible]
6B	793.2	655.7	136.5	310.7	260.5	50.2
5D	716.6	650.1	66.5	312.6	260.4	51.7
6C	733.0	627.8	105.2	303.0	[illegible]	44.5
6G	722.0	668.9	53.1	289.2	[illegible]	[illegible]
6L	797.2	664.1	133.2	311.1	[illegible]	[illegible]
6P	[illegible]			277.0		
7B	752.1	612.5	141.6	291.8	[illegible]	[illegible]
7E	725.1	671.2	54.1	297.0	272.5	24.4
7F	710.2	667.9	42.3	287.4	[illegible]	32.9
7M	792.1	697.8	94.3	320.3	270.9	49.4
7R	635.1	623.1	12.0	283.7	251.4	[illegible]
8B	792.3	672.2	120.1	322.8	274.5	48.3
8E	670.1	614.7	55.4	292.7	271.8	
8H	688.6	622.8	65.8	286.8	219.8	67.0
8N	745.8	672.4	73.4	321.0	266.6	54.2
9C	741.7	636.5	105.2	322.8	255.1	67.7
9H	745.9	637.3	108.6	325.8	249.4	76.4

160 082

Point Inst[illegible]

TIC Resistance [illegible] To [illegible]

4/9/[illegible]

Cable Location	Resistance From Babcock & Wilcox Cable Room Chromel to End	Post Installation Resistance Measurement Belfab T/C Only Chromel to End	Resistance Difference (1) - (2)	Measured Resistance From Cable Room Alumel to End	Post Installation Resistance Measurement Belfab T/C Only Alumel to End	Resistance Difference (4) - (5)
9M	959.4 Ω	674.3 Ω	285.1 Ω	304.7 Ω	269.5 Ω	35.2 Ω
9N	842.5	682.5	160.0	353.2	272.1	81.1
10M	680.5	615.1	65.4	275.2	245.7	29.5
10R	761.1	643.5	117.4	343.0	257.2	85.8
11K	755.3	709.3	49.0	305.3	283.5	22.8
11L	735.1	678.9	106.2	321.0	272.6	48.4
12F	792.5	673.3	119.2	303.0	266.6	74.2
12K	888.8	688.8	200.0	304.5	282.6	111.9
12C	745.1	627.3	117.8	332.0	268.6	63.4
12F	870.8	686.0	184.8	393.5	272.1	121.4
13G	783.9	688.2	95.7	344.9	273.9	71.0
13H	814.2	624.6	189.6	365.5	268.1	137.4
14D	804.9	673.1	136.8	402.4	232.7	169.4
14M	720.5	627.3	93.2	298.3	253.5	44.8

Calculated Resistance Difference

Chromel to end 171 Ω

Alumel to end 71.2 Ω

Based on 450' of # 20 stranded type K thermocouple extension wire from cable room to inside assembly connector.

160 083

Post Installation T/C Resistance Data From 7/24/79

4/14/79

Core Location	T/C Leg Resistance from Babcock & Wilcox Cable Room	Resistance Measurement Belted T/C Only Loop R	Resistance Difference (1) - (2)	Measured T/C Resistance From Cable Room
3F	1241.4 Ω	937.2 Ω	304.2	
4E	1164.3	911.6	253.2	
10D	1030.2	953.5	76.7	
11E	1030.1	964.5	65.6	
9E	963.3	874.5	88.8	
14M	1013.7	875.2	138.5	
12O	1059.8	911.3	148.5	
8H	964.5	872.2	92.3	
1H	1072.8	931.1	141.7	
2G	1053.8	880.2	173.6	
2L	1125.9	934.3	191.6	
3M	1250.8	872.5	378.3	
4N	1096.3	878.4	217.9	
5D	1174.9	[illegible]	[illegible]	
5G	1044.8	[illegible]	[illegible]	
5H	[illegible]	[illegible]	[illegible]	1303.2 Ω
5K	1076.5	915.9	160.6	
5D	1071.2	935.2	136.0	
6C	1093.0	[illegible]	157.6	
6E	1009.2	975.1	34.1	1030.0
6L	1093.3	920.1	173.2	
6P	1091.6			
7B	1055.0	857.9	197.1	
7E	1032.0	957.1	74.9	
7F	[illegible]	922.3	73.3	
7M	1125.4	974.3	151.1	
7R	979.4	878.6	99.8	
8B	1035.1	876.2	159.9	
8F	871.5	865.7	5.1	
Report 8H	965.4	872.7	93.2	961.1
8N	1066.8	933.8	133.0	
9C	1004.5	848.8	155.7	
9H	1054.7	891.0	163.7	1052.1
9M	1254.1	942.4	311.7	1230.5

Post Installation T/C Resistances Obtained From [illegible] 48-23 Rev

Cable Location	Estimated Measured Loop Resistance From Cable Room	Post Installation Resistance Measurement Dated T/C Only Loop R	Resistance Difference (1) - (2)	Loop R Measured T/C Resistance From Cable Room
9N	1105.7 Ω	954.2 Ω	241.5 Ω	
10M	955.7	860.4	95.3	
10R	1104.1	899.9	204.2	
11K	1063.9	991.3	72.6	
11L	1106.1	950.4	155.7	
12F	1135.6	941.5	194.1	
12K	1233.3	968.9	214.4	
12L	1077.1	895.2	181.9	
13F	1251.3	957.6	293.7	
13G	1123.3	956.6	167.2	
13H	1199.5	977.2	222.3	
13L	175 kΩ			
14D	1215.3	949.7	265.6	
14M	1018.3	880.2	138.1	

Calculate Resistance Difference: 242.2

Based on 450' of #20 stranded type K thermocouple extension wire from cable room to inside containment.

160 085

POST INSTALLATION T/C RESISTANCES OBTAINED FROM 03332/2C

CHROMEL Δ

X

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B							142	107							
C						105			105				118		
D					173					50				137	
E				161			54		66		45				
F			155				11/16	60				119	185		
G		117			60	53			58				96		
H	116				337			65	109				189		
K					107						49	200			
L		98				133					106				
M			201				98		285	65				93	
N				108				98	160						
O												95			
P															
R							67			118					

Y

Z

W

T/C RESISTANCE DIFFERENCES

DIFFERENCE = LOOP R(ACTUAL) − LOOP R(measured)

160 086

ALUMEL Δ

X

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B							56	52							
C						50			48				63		
D					74					27				130	
E				91			24		27		23				
F			98				22					74	108		
G		56			26	26			23				71		
H	49				29			27	59				137		
K					54						23	112			
L		93				46					48				
M			176				52		26	30				45	
N				109				54	81						
O												53			
P															
R							32			86					

W

Z

Y

T/C RESISTANCE DIFFERENCES

DIFFERENCE = LOOP $R_{(ACTUAL)}$ − LOOP $R_{(MEASURED)}$

160 087

+15179

[illegible] ANALYSIS

	No.	CR/GD - Current (I)	AL-GD Current	CR-AL Walk DA	CR-GD-R OT	[illegible]	[illegible]	AL-GD Ω Comment
1352 [illegible] 344	527	2.45×10^{-6}	2.29×10^{-6}	-.00493	861.6Ω	1207.[illegible]	1121.[illegible]	379.8 Ω
09[illegible]-TE 1344-B	526	2.45×10^{-6}	8.03×10^{-6}	.00422	213.5Ω	1171.2	1125.4	351.3 Ω
CD-TE 1400-B	519	2.55×10^{-6}	9.16×10^{-6}	.00472	731.8Ω	1027.4	1010.1	292.[illegible] Ω
11E-[illegible] 1412-B	518	2.55×10^{-6}	9.14×10^{-6}	.00472	731.4Ω	1020.0	1010.[illegible]	297.7Ω
[illegible]-7E 1422-B	447	3.32×10^{-6}	10.39×10^{-6}	.00538	625.7Ω	961.5	951.2	277.6Ω
11[illegible] 1431-B	517							
9[illegible] 1464-B	495	2.37×10^{-6}	11.22×10^{-6}	.00539	693.5Ω	972.5	923.0	271.1Ω
A[illegible] 1[illegible]-B	541	2.32×10^{-6}	3.50×10^{-6}	.00490	720.4Ω	1015.9	1006.0	290.3Ω
[illegible]E 1557 (BKG-A)	540	2.72×10^{-6}	9.07×10^{-6}	[illegible]	746.7Ω			313.1Ω
0[illegible]	[illegible]	2.73×10^{-6}	16.45×10^{-6}	.00722	622.1Ω			276.9Ω
1368-B 01[illegible]-TE	529	2.75×10^{-6}	2.75×10^{-6}	.00498	756.1Ω			314.7Ω
1366-B [illegible]-TE	528	2.66×10^{-6}	9.28×10^{-6}	.00482	745.9Ω	* Drift		307.9Ω
1376-B [illegible]-E	530	2.67×10^{-6}	7.26×10^{-6}	.00496	765.2Ω			364.1Ω
1384-B [illegible]-TE 1392-B	531							
[illegible] 1400-B	532	2.54×10^{-6}	6.20×10^{-6}	.00490	824.5Ω			426.3Ω
13[illegible]-B [illegible]-TE	533	2.91×10^{-6}	8.04×10^{-6}	.00436	734.9Ω			361.4Ω
1144-B [illegible]-TE	525	2.53×10^{-6}	2.20×10^{-6}	.00494	832.7Ω			341.2Ω * Drift
1152-B [illegible]-TE	501	3.20×10^{-6}	13.60×10^{-6}	.00452	745.5Ω			239.3Ω
1160-B [illegible]X-TE	502	2.45×10^{-6}	12.25×10^{-6}	.00625	1017.7Ω	* Drift 1303.2Ω		301.0Ω
1168-B [illegible]E	503	2.74×10^{-6}	7.20×10^{-6}	.00502	762.2Ω			314.3 * Drift
[illegible]-B [illegible]-TE	534	2.79×10^{-6}	9.28×10^{-6}	.00492	714.6Ω			256.6 * Drift
1136-B [illegible]G-TE 1144-B	524	2.84×10^{-6}	9.23×10^{-6}	.00484	733.0Ω			302.0Ω
	500	2.80×10^{-6}	11.97×10^{-6}	.00551	720.0Ω	1006.0Ω		289.2Ω

60 083

SA-CORE THERMOCOUPLE NOISE ANALYSIS

Point Name	Point A.C.	Disconnect Time	Reconnect Time	Date	Temp °F	MSV (V²) C-C/2	MSV (V²) C-AVE	Comment
1416-B 160-TE	535	Not Hook Up						
1416-B 1P-TE	536	2.56×10^{-6}	7.82×10^{-6}	.00497	824.6			377.0
1320-B 178-TE	523	2.57×10^{-6}	8.92×10^{-6}	.00467	754.1			321.8
1120-B 17E-TE	499	2.36×10^{-6}	7.02×10^{-6}	.00471	738.1			297.7
1120-B 17F-TE	498	2.49×10^{-6}	7.78×10^{-6}	.00400	714.2			282.4
1176-B 17M-TE	505	2.56×10^{-6}	8.33×10^{-6}	.00438	796.1			329.3
1432-B 17N-TE	537	2.31×10^{-6}	7.53×10^{-6}	.00425	625.1			293.3
1232-B 16B-TE	522	2.50×10^{-6}	8.30×10^{-6}	.00473	739.3			326.9
1164-B 15E-TE	492	1.29×10^{-6}	7.73×10^{-6}	.00502	576.1			196.7
1048-B 14H-TE	493	4.64×10^{-6}	13.11×10^{-6}	.00771	588.6	965.1		276.7 PLENUM
1124-B 14N-TE	506	2.35×10^{-6}	9.75×10^{-6}	.00107	749.7			321.0
1320-B 12-TE	521	2.79×10^{-6}	9.45×10^{-6}	.00494	741.7			347.1
1032-B 11H-TE	494	2.71×10^{-6}	9.05×10^{-6}	.00484	748.6	1055.1		304.9
1032-B 11M-TE	508	2.00×10^{-6}	12.95×10^{-6}	.00534	952.4	1232.5		291.7
1192-B 11N-TE	507	2.50×10^{-6}	7.99×10^{-6}	.00493	842.5	1179.9		353.2
1296-B 10L-TE	520	Not Hook Up						
1208-B 10M-TE	509	3.16×10^{-6}	10.07×10^{-6}	.00539	870.5	953.4		275.2
1448-B 10O-TE	539	Not Hook Up						
1448-B 10R-TE	538	2.60×10^{-6}	7.08×10^{-6}	.00474	761.1	1095.1		343.0
1224-B 11K-TE	511	2.91×10^{-6}	7.67×10^{-6}	.00520	759.35	1031.8		305.6
1216-B 11L-TE	510	2.67×10^{-6}	8.49×10^{-6}	.00482	795.1	1099.0		321.0
1[illegible]-B 11[illegible]-TE	516	2.34×10^{-6}	7.92×10^{-6}	.00473	792.5	1239		343.1
1232-B 1[illegible]-TE	512	2.25×10^{-6}	6.73×10^{-6}	.00474	882.8	1244.5		394.5
984-B 1[illegible]-TE	544	[illegible]	[illegible]	[illegible]				

IN-CORE THERMOCOUPLE NOISE ANALYSIS

Point Source	Point NO.	DISCONNECT TIME	RECONNECT TIME	DATE	TEMP °F	MSV(V²) 0-0.2Hz	MSV(V²) 0-1.6Hz	COMMENT
1256-B TM-13E-TE	515	2.25×10^{-6}	2.25×10^{-6}	.00471	576.5	1224.9	380.5	
1243-B TM-13G-TE	514	2.55×10^{-6}	7.99×10^{-6}	.00470	753.9	1121.2	341.9	
1246-B TM-13K-TE	513	2.45×10^{-6}	7.29×10^{-6}	.00470	814.0	1132.5	[illegible]	
1492-B TM-13L-TE	542	3.19×10^{-9}	4.66×10^{-9}	.00041	[illegible]	[illegible]	80.1	Drift
1465-B TM-14D-TE	543	2.45×10^{-6}	7.51×10^{-6}	.00476	[illegible]	[illegible]	[illegible]	
(1464-B) TM-14M-TE	541	2.91×10^{-6}	9.31×10^{-6}	.00480	725.[illegible]	1216.[illegible]	278.5	REPEAT

160 090

T/C POST INSTALLATION RESISTANCE MEASUREMENTS
DATA FROM TP 302/2C

Sec No	String Loc		R_P	R_n	R_{LOOP} R_T (Ω)
255	1	H-8	622.8 Ω	249.8 Ω	872.2
292	2	H9	637.3	249.4	891.0
269	6	F7	667.9	265.4	922.3
260	7	E7	684.6	273.5	957.1
266	8	G6	666.9	263.0	925.1
262	9	G5	685.5	273.4	960.9
249	4	F5	614.7	250.8	865.7
244	3	G9	635.4	258.2	890.1
256	5	E9	620.0	250.5	874.5
264	10	H5	680.9	271.6	952.2
263	11	K5	655.7	260.5	915.9
281	12	L6	664.0	265.4	929.1
265	13	M7	697.8	276.9	974.3
290	14	N5	670.4	266.8	936.8
268	15	N9	682.5	272.1	954.2
271	16	M9	674.3	268.5	942.4
240	17	M10	615.1	245.7	860.4
241	18	L11	678.9	272.6	950.4
272	19	K11	709.3	282.5	991.3
278	20	K12	688.8	282.6	968.9
253	21	H13	624.6	248.1	872.2

POST INSTALLATION RESISTANCE MEASUREMENTS OF BELFAB INCORE ASSEMBLY THERMOCOUPLES OBTAINED FROM POST INSTALLATION CHECK TP 302/2C

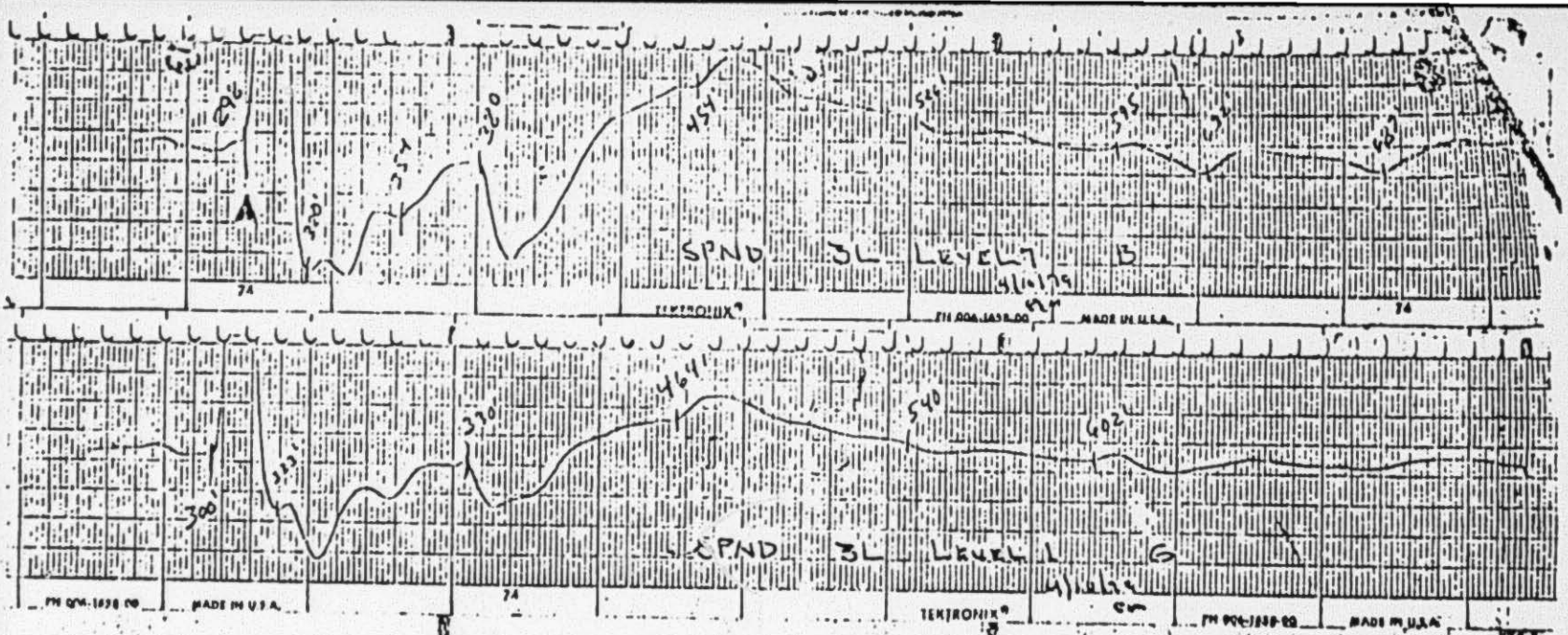
Ser. No	String	Loc	R_p	R_n	R_T (MΩ) R LOOP
276	22	G13	688.2 Ω	273.4 Ω	961.6 Ω
259	23	F13	686.0	272.1	957.6
261	24	F12	673.3	268.8	941.5
285	25	G11	637.9	256.8	896.4
248	26	E11	687.4	274.4	964.5
267	27	D10	682.1	271.7	953.5
270	28	C10	677.3	270.6	946.7
275	29	C9	636.5	255.1	888.6
273	30	B8	692.2	274.5	966.2
243	31	B7	612.5	245.8	857.9
282	32	C6	627.8	252.5	877.4
280	33	D5	650.1	267.4	935.2
258	34	E4	652.5	260.0	911.6
252	52	C13	627.3	268.6	895.2
247	51	D14	673.1	275.7	948.7
243	50	L13	641.2	256.9	898.4
245	49	M14	627.3	253.5	880.2
289	48	O12	652.0	260.0	911.3
291	47	O10	636.0	253.8	888.9
288	46	R10	643.5	257.2	899.9
286	43	O6	636.2	257.7	893.0

160 092

T/C POST INSTALLATION RESISTANCE MEASUREMENTS
DATA FROM TP302/2C

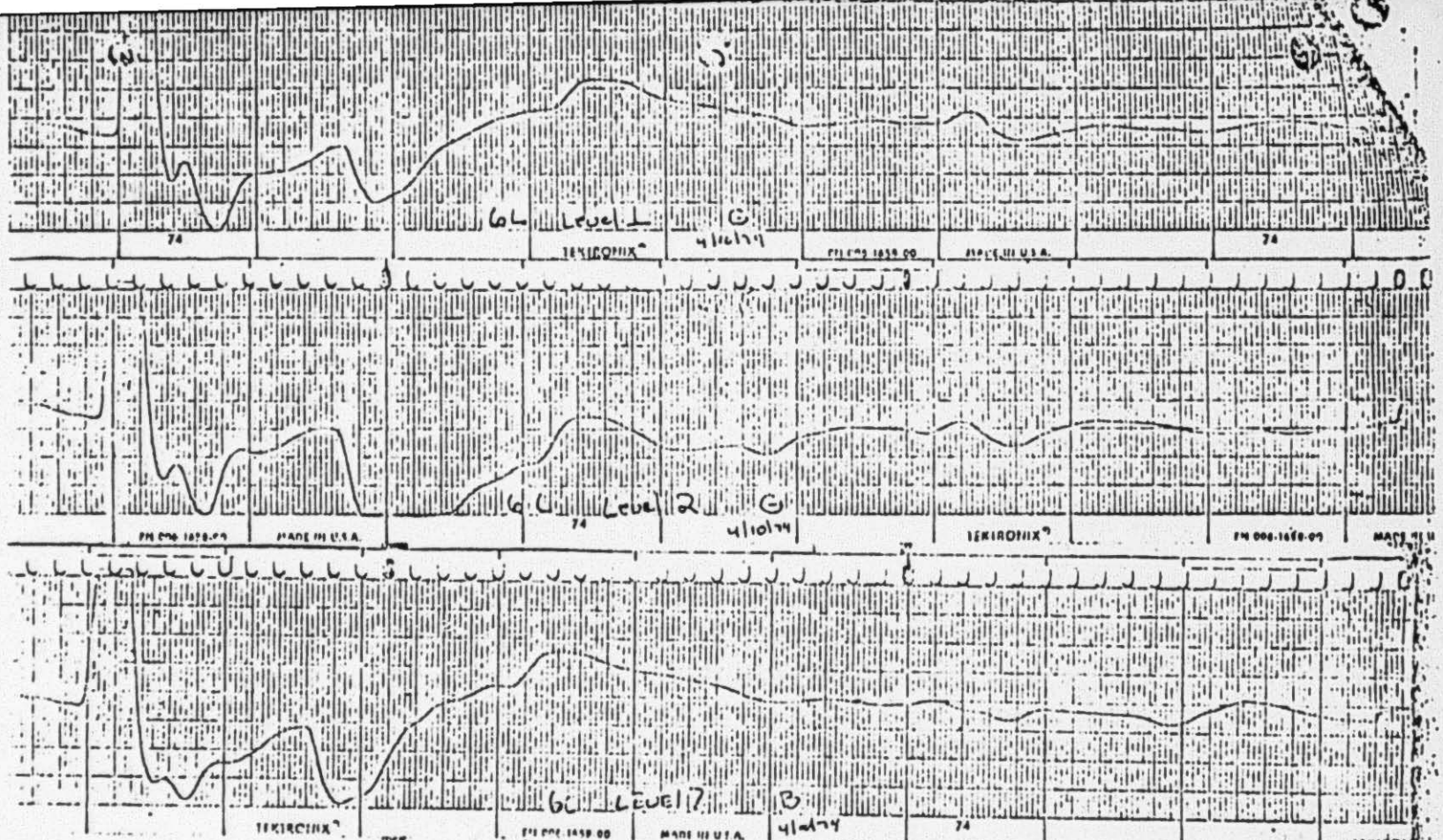
Ser No	String	R_0	R_i	R_{LOOP} R_T (MEAS)
251	42 G5	615.8 Ω	248.8 Ω	863.9 Ω
277	44 D6	652.5	260.6	912.2
287	45 R7	628.1	251.4	879.6
254	41 H4	626.7	252.5	879.4
242	40 M3	623.2	250.4	872.8
284	39 43	669.7	268.8	938.7
250	37 H1	640.1	267.9	931.1
257	38 L2	668.3	267.0	934.3
246	36 G2	628.5	252.4	880.2
283	35 E3	706.3	281.6	987.2

160 093



160 094

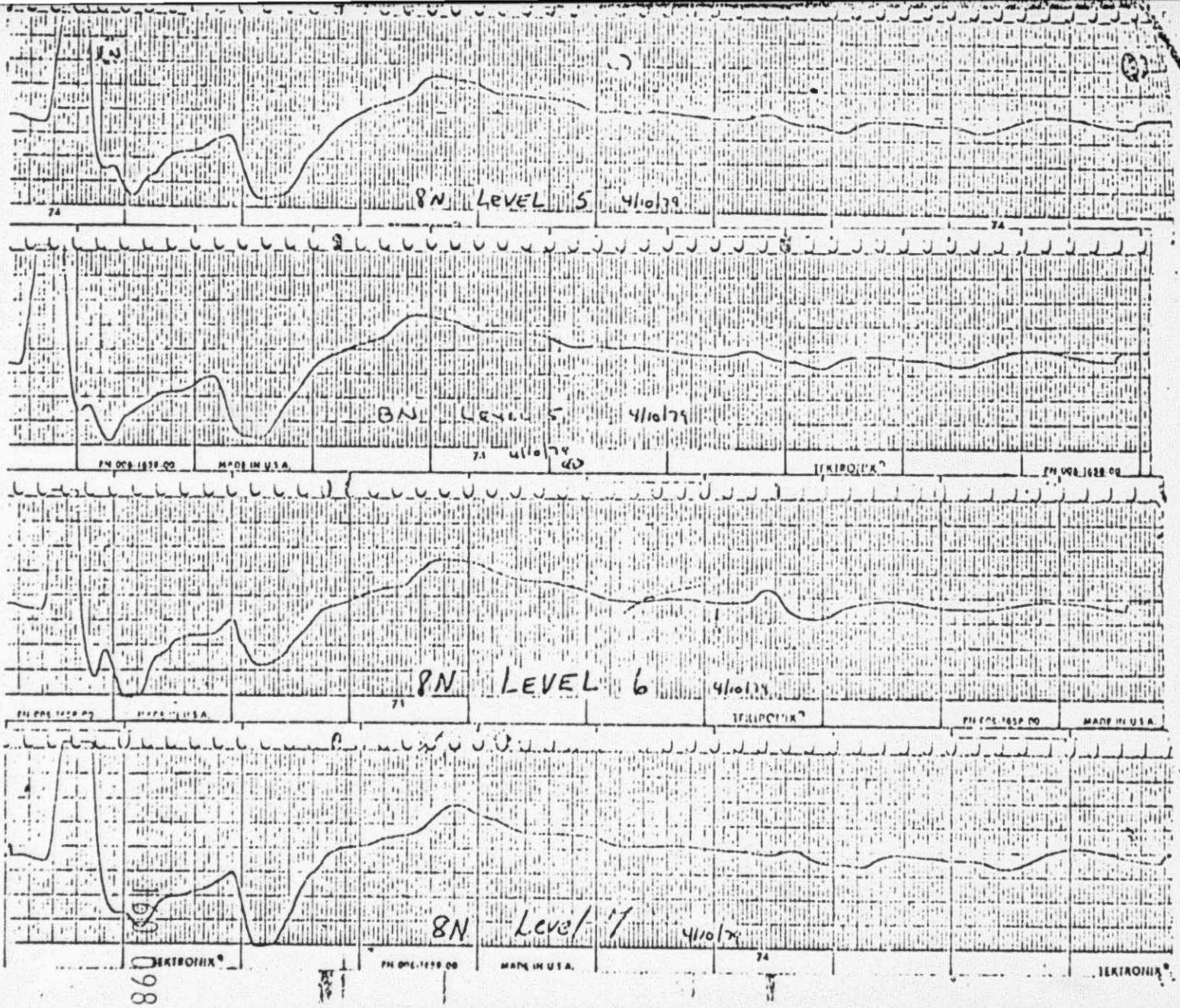
160 095

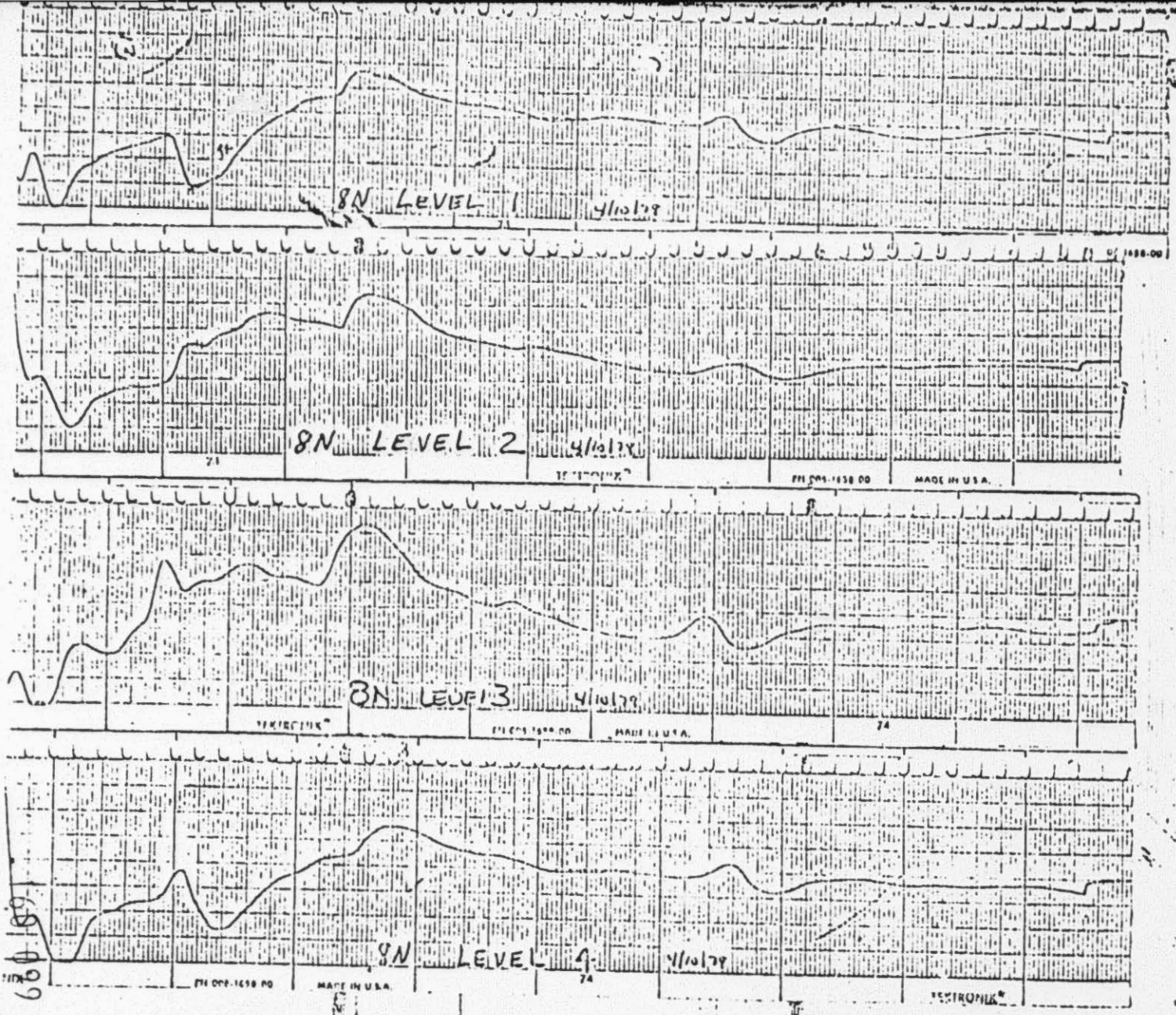

74
TEKTRONIX
MADE IN U.S.A.
Level 1
4/10/74
Level 2
4/10/74
Level 7
4/10/74

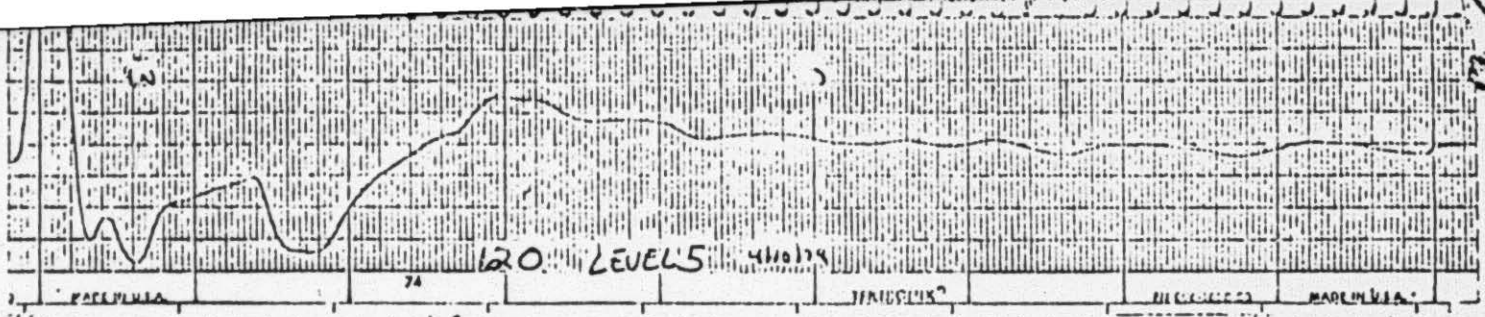
960 096

THERMOCOUPLE
T/C 2L
Yellow
TEKTRONIX
T/C 2L
COMPUTER PT 530
Red
TEKTRONIX
T/C 2L
TEKTRONIX
MADE IN U.S.A.

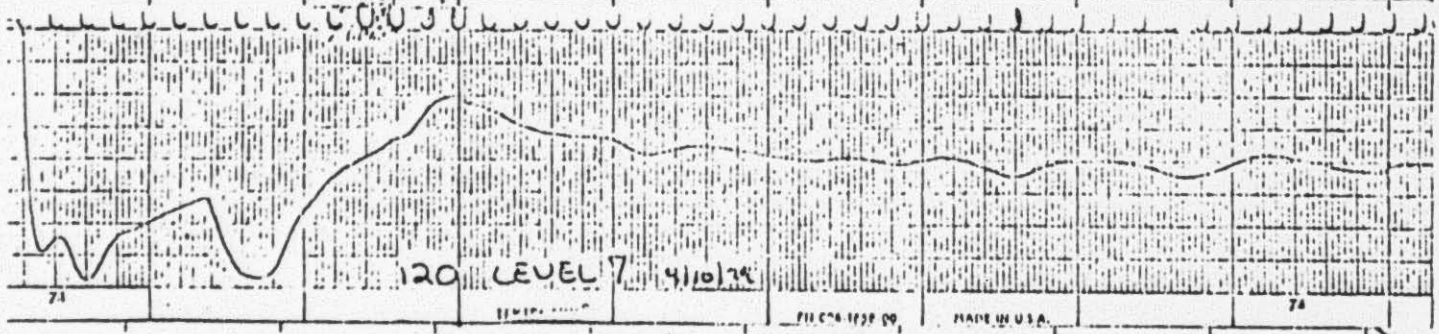
160 097

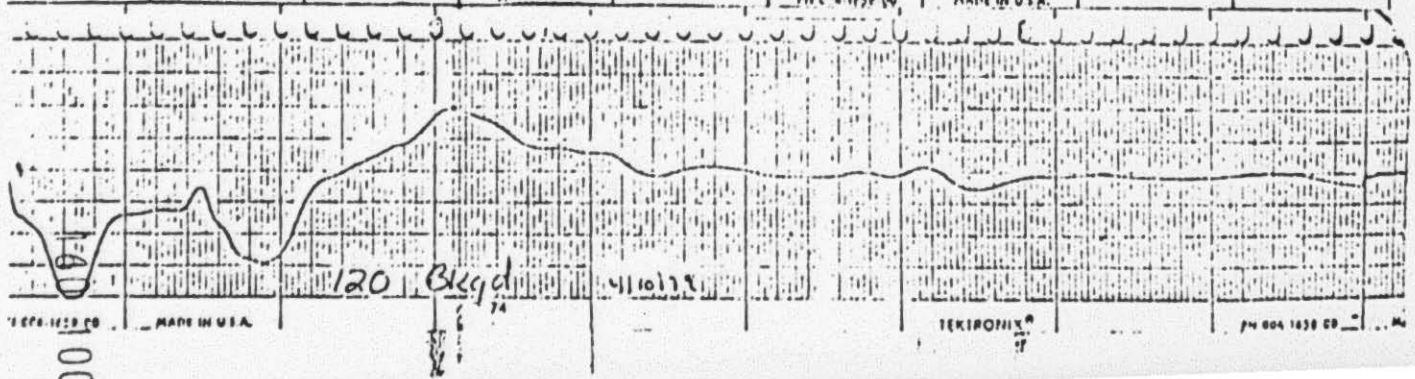

8N LEVEL 5 4/10/79
8N LEVEL 5 4/10/79
8N LEVEL 6 4/10/79
8N Level 7 4/10/79
TEKTRONIX
MADE IN U.S.A.

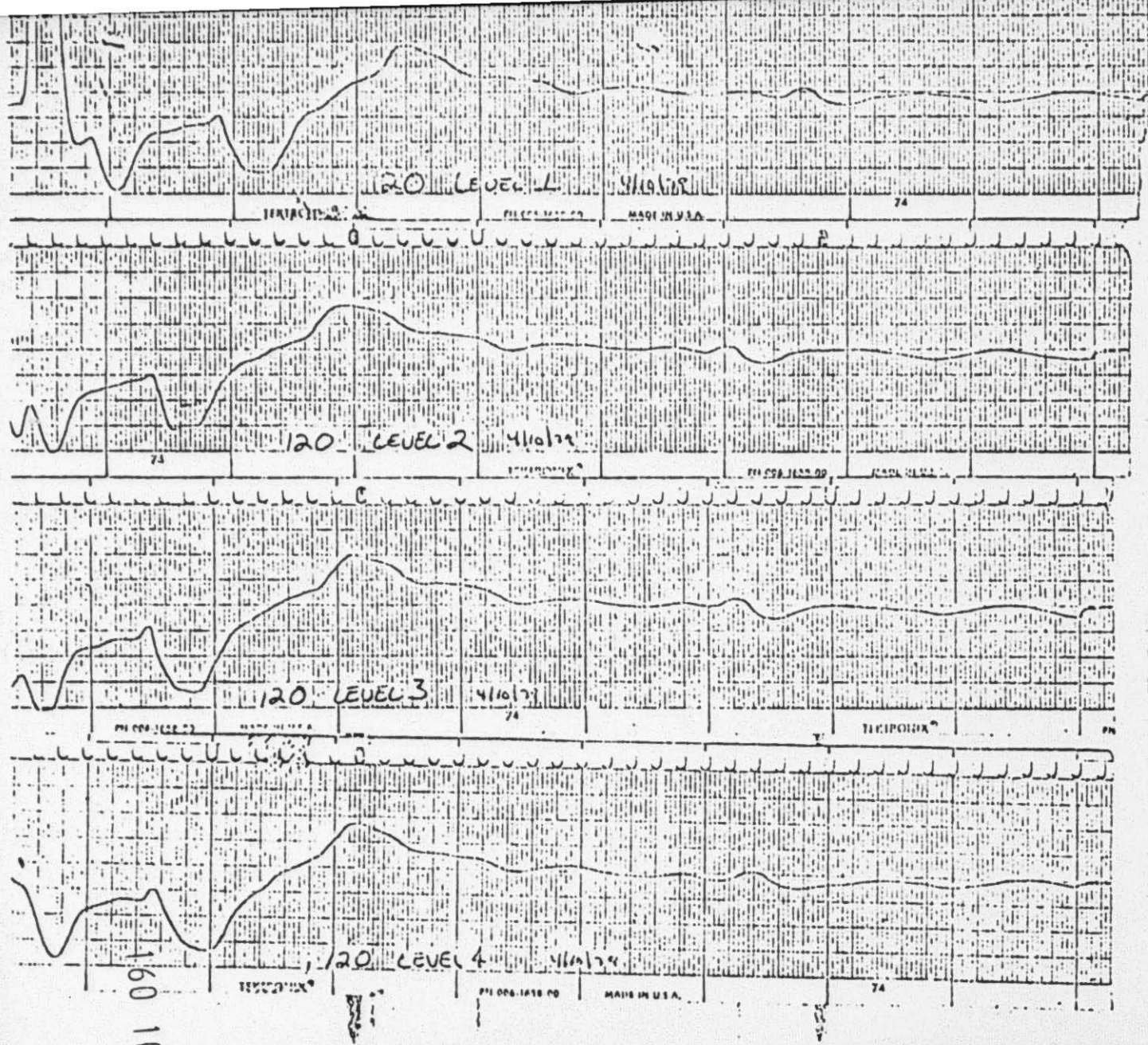

8N LEVEL 1
8N LEVEL 2
8N LEVEL 3
8N LEVEL 4
MADE IN U.S.A.
TEKTRONIX


120 LEVEL 5 4/10/78
74
TEKTRONIX
MADE IN U.S.A.

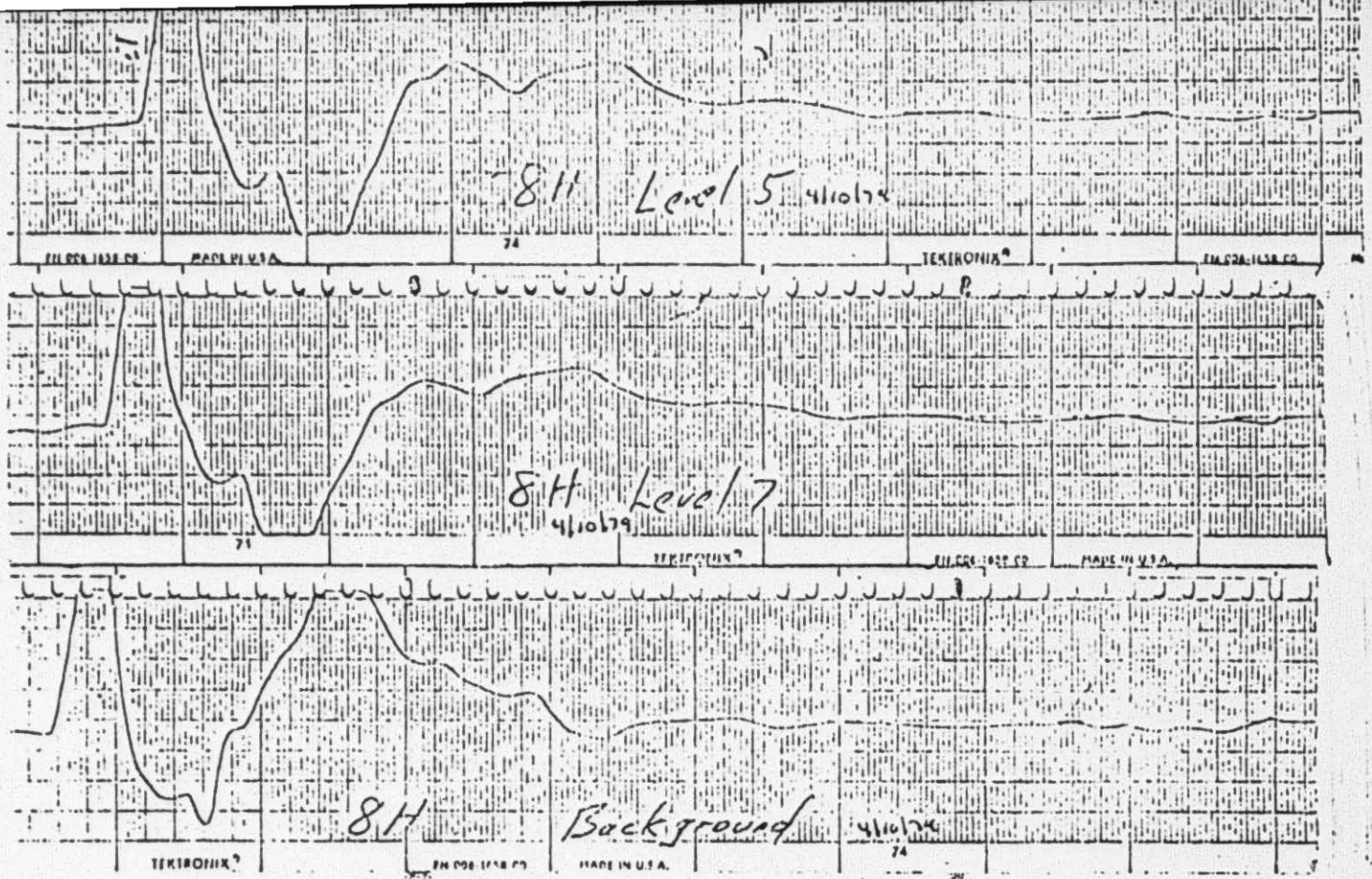
120 LEVEL 6 4/10/78
74
TEKTRONIX
MADE IN U.S.A.


120 LEVEL 7 4/10/78
74
MADE IN U.S.A.

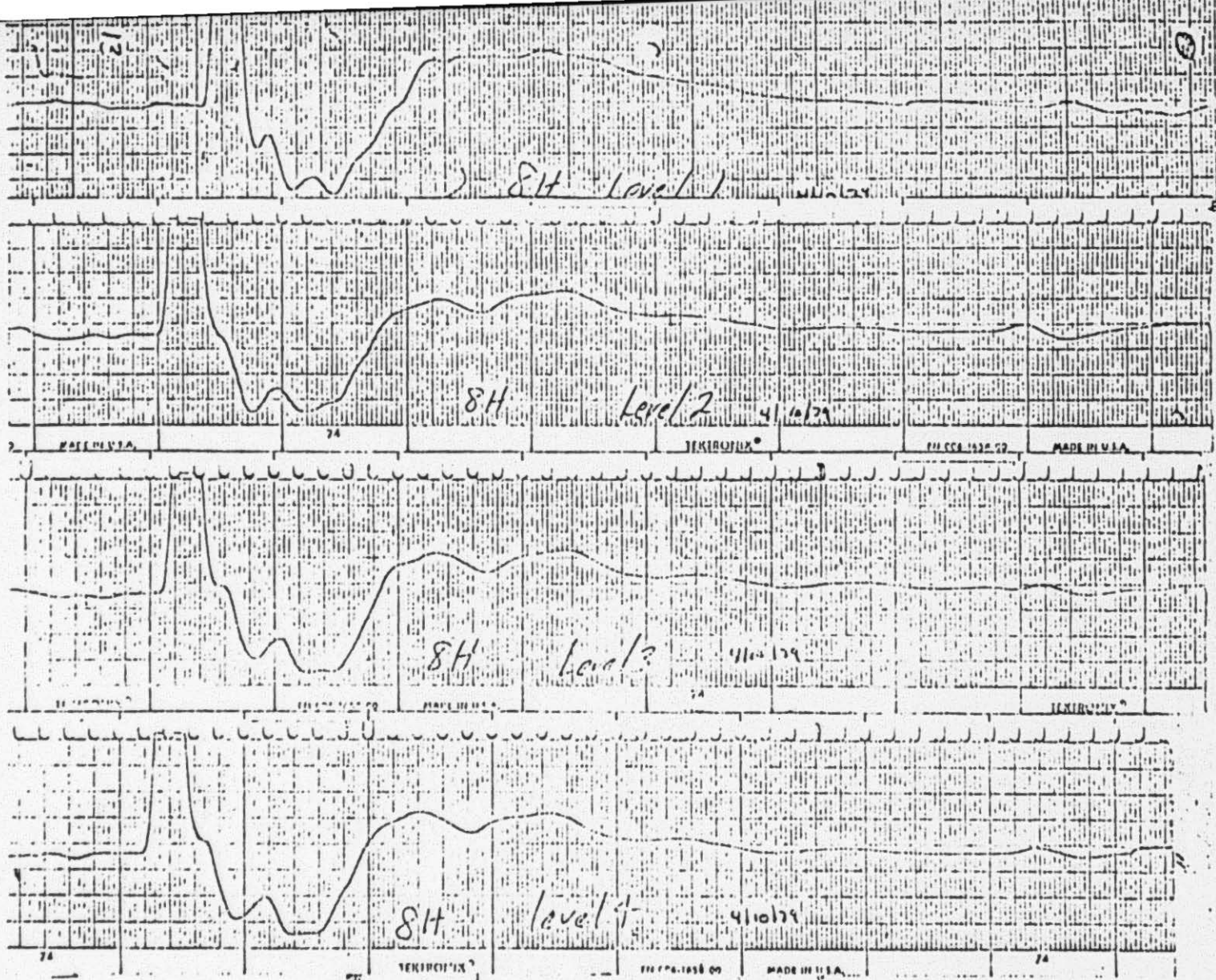

120 Bkgd 4/10/78
74
MADE IN U.S.A.
TEKTRONIX


120 LEVEL 1 4/10/79
120 LEVEL 2 4/10/79
120 LEVEL 3 4/10/79
120 LEVEL 4 4/10/79
MADE IN U.S.A.

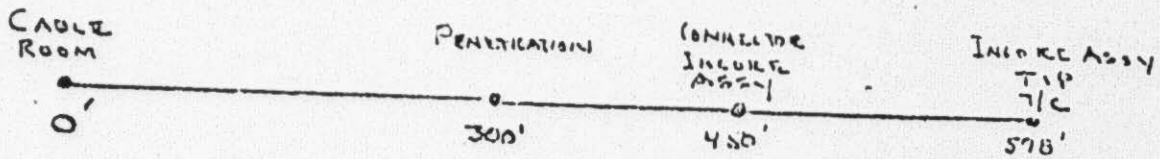
160 102


8H Level 5 4/10/79
8H Level 7 4/10/79
8H Background 4/10/79
TEKTRONIX
MADE IN U.S.A.

160 103


8H level 1
8H level 2 4/10/79
8H level 3 4/10/79
8H level 4 4/10/79
TEKTRONIX
MADE IN U.S.A.

160 10


CABLE ROOM
PENETRATION
CONNECTOR INCORE ASSY
INCORE ASSY TIP T/C
0'
300'
450'
578'

common resistance

T_c - 277° 1400

CORE LOCATION	DETECTOR LEVEL	COMPUTER POINT	CURRENTS, MA 0V	+10V	−10V	R Ω
12-O	1	1456	0.196	−15	+5	1×10
	2	1457	0.209	−2.5	+3.5	3.3×10
	3	1458	0.250	−2.7	+3.6	3.2×10
3-L	1	1472	0.18	−3.6	+4.5	2.5×10
	2	1473	0.247	−4.5	+5.5	2.0×10
10-R	1	1440	0.114	−3.2	+3.6	2.34×10^{9}
	4	1443	0.043	−2.3	+2.8	[illegible]
10-O	1	1448	0.145	−3.2	+3.8	[illegible]
13-C	1	1488	0.23	−2.7	+3.4	[illegible]
	3	1490	0.248	−3.3	+4.0	[illegible]
	5	1492	0.292	−3.1	+4.3	[illegible]
6-O	1	1416	0.297	−2.8	+3.6	[illegible]
	2	1417	−67.7	-1.34×10^{-3}	$+2.24 \times 10^{-3}$	[illegible]
4-N	1	1400	0.275	−7.1	+8.2	[illegible]
	2	1401	0.330	−4.0	+5.1	[illegible]
[illegible] N	1	1192	+19.6	−35.5	+37.0	[illegible]
3-M	2	1393	0.305	−3.7	+4.7	[illegible]
8-N	1	1184	≈ 1000	-8.9×10^{-4}	$+20.0 \times 10^{-4}$	6.9×10^{3}
	2	1185	+54	-2.05×10^{-5}	$+2.05 \times 10^{-5}$	[illegible]
	3	1186	0.025	−3.7	+4.8	[illegible]
2-G	1	1260	± 95	-1.36×10^{-3}	$+2.24 \times 10^{-3}$	5.87×10^{3} *
	2	1261	≈ 200	-1.35×10^{-3}	$+2.02 \times 10^{-3}$	[illegible] *
3-F	1	1352	0.189	−4.6	+4.0	[illegible]
	2	1353	0.263	−3.9	+5.0	[illegible]
4-E	1	1344	0.233	−4.7	+5.5	[illegible]
	2	1345	0.316	−3.8	+5.2	[illegible]
3-L	1	1384	0.406	−18.6	+18.2	[illegible] *
	2	1385	0.329	−4.0	+4.0	5.13×10^{9}
5-D	2	1337	0.260	−2.8	+3.6	3.13×10^{9}
6-C	1	1328	0.228	−2.4	+3.3	3.51×10^{9}
	2	1329	0.315	−2.6	+3.4	3.33×10^{9}
7-B	2	1321	+158	-2.6×10^{-5}	$+2.7 \times 10^{-5}$	[illegible] *
[illegible]	2	1249	+11.8	-2.23×10^{-7}	$+2.46 \times 10^{-7}$	[illegible] *
8-B	1	1312	0.177	−2.5	+3.4	3.39×10^{9}
10-C	1	1296	0.192	−3.8	+4.5	[illegible]
	2	1297	[illegible]	[illegible]	[illegible]	[illegible]

Tc = .377 1100 11 [illegible] 9

CORE LOCATION	DETECTOR LEVEL	COMPUTER POINT	CURRENTS, μA 0V	+10	−10V	R, Ω
11-G	1	1272	≃ 0.1	−111	+92	9.2 x 10^7
12-K	1	1232	+20.6	−50.9 x 10^-6	+50.8 x 10^-6	1.97 x 10^6
	2	1233	0.243	−2.8	+4.0	[illegible] x 10^7
11-L	1	1216	+75	−1.94 x 10^-5	+1.94 x 10^-5	5.15 x 10^5
6-L	1	1168	0.228	−20	11	.645 x 10^7
	2	1169	0.56	−33.3	+39	.278 x 10^7
9-H	1	1088	0.225	−3.2	+4.2	2.7 x 10^4
8-H	BKGD	1087	0.023	−3.5	+4.3	2.56 x 10^9
13-H	1	1240	0.156	−3.1	+3.8	2.9 x 10^9
	2	1241	0.156	−21.4	+21.0	.27 x 10^4

* Detector failed or failing

H. D. Warren

BACKUP RECORDER
TRACING OF INCORE
DETECTOR SIGNALS
DURING INITIAL EVENTS

ROD DROP
AT 4:00 A.M.
3/28/79

6:30 A.M.

POWER
AT TRIP

NOON

1 AM

2 AM

3 AM

4 AM

5 AM

6 AM

160 108

BACKUP RECORDER
TRACING OF INCORE
DETECTOR SIGNALS
DURING INITIAL EVENTS

TOD DROP
AT 7:00 A.M.
3/28/79

6:30 A.M.

REACTOR
AT POWER

NOON
1 AM
2 AM
3 AM
4 AM
5 AM
6 AM
7 AM
8 AM
9 AM
10 AM
11 AM
12 PM

160 109